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**A METHOD AND APPARATUS FOR UPDATING NEW VERSIONS OF
FIRMWARE IN THE BACKGROUND**

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BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates to an improved data processing system and, more particularly, to an improved
10 method of updating firmware.

2. Description of Related Art:

Currently, many of the more complex computers that are used for services such as web servers are
15 multiprocessor computers. These computers often have a "service processor" that is used to perform many tasks that affect the computer as a whole, such as, for example, monitoring the temperature of the computer so that the exhaust fan may be turned on and off at
20 appropriate times. The service processor may also monitor other resources within the system shared by the many different host operating systems that may be executing on the computer.

The service processor, during a power on event to
25 the computer, executes a variety of tasks contained in firmware. One of the functions performed by the service processor during this power on event is to broadcast the power on event to all tasks, including the system power control network (SPCN) task. When the SPCN task receives
30 the power on event, it will collect the firmware level information on the SPCN card while the system is booting up. At this time, the SPCN task will read the SPCN

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firmware level (i.e. version) on the service processor
flash. If that firmware level does not match with the
level of firmware on the SPCN card, then the SPCN task
will transmit a new SPCN firmware image to the SPCN card
5 while the OS is running. This SPCN firmware typically
takes 45 minutes to complete for a four (4) drawer
computer system. If there are more drawers in the
system, then it will take longer than 45 minutes to
update. Currently, the operating system cannot be loaded
10 until this firmware update is finished. Thus, the user
may have to wait an hour or more before the system is
usable. Therefore, it would be desirable to have a
method of updating the SPCN firmware that allowed the
computer to be usable for other tasks sooner than current
15 systems.

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SUMMARY OF THE INVENTION

5 The present invention provides a method, system, and
computer program for updating system firmware in a data
processing system as a background operation allowing a
user to utilize the computer for other purposes during
the update process. In one embodiment, after an
10 operating system has been loaded and control has been
transferred from the service processor to the host, the
service processor determines whether the level of a
firmware copy on a system component, such as an SPCN
card, matches the current level of firmware stored on a
15 non-volatile memory accessible to the service processor.
If the level of the firmware copy in the component is
different from the current level, the service processor
transfers the current level of firmware from the
non-volatile memory accessible to the service processor
20 to the system component.

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BRIEF DESCRIPTION OF THE DRAWINGS

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The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 depicts a block diagram of a data processing system in which the present invention may be implemented;

Figure 2 depicts a block diagram of a system for managing a system I/O drawers connected to multiple networks in accordance with the present invention; and

Figure 3 depicts a flowchart illustrating an exemplary process for updating a new version of firmware for an SPCN card as a background operation in accordance with the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures, and in particular
5 with reference to **Figure 1**, a block diagram of a data
processing system in which the present invention may be
implemented is depicted. Data processing system **100** may
be a symmetric multiprocessor (SMP) system including a
plurality of processors **101**, **102**, **103**, and **104** connected
10 to system bus **106**. For example, data processing system
100 may be an IBM RS/6000, a product of International
Business Machines Corporation in Armonk, New York,
implemented as a server within a network. Alternatively,
a single processor system may be employed. Also
15 connected to system bus **106** is memory controller/cache
108, which provides an interface to a plurality of local
memories **160-163**. I/O bus bridge **110** is connected to
system bus **106** and provides an interface to I/O bus **112**.
Memory controller/cache **108** and I/O bus bridge **110** may be
20 integrated as depicted.

An RIO Controller **140** provides an interface between
processors **101-104** and local memories **160-163** with I/O
drawers **144-150**. I/O drawers **144-150** collectively
comprise an expansion tower. I/O drawers **144-150** are
25 powered independently from the rest of the data
processing system containing the processors **201-204** and
memory **160-163**. Connection between the I/O drawers
144-150 and RIO Controller is made through buses **180-185**
as depicted which consist of cables including System
30 Power Control Network (SPCN), Remote Input Output (RIO)

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cables, JTAG buses, and operator panel cables. Bus **180** provides a connection between node 0 of RIO Controller **140** and I/O drawer **144** which is in turn connected to I/O Drawer **146** through bus **181**. A return bus **182** connects
5 I/O Drawer **146** to node 1 of RIO Controller **140**. Similarly, buses **183-185** are used to connect I/O drawer **148** and **150** to nodes 2 and 3 of RIO Controller **140**. Each I/O Drawer **144-150** holds up to 14 PCI I/O adapters. Four succinct PCI buses are present in each of I/O drawers
10 **144-150**. Each of I/O drawers **144-150** provides space for up to four media devices, such as, for example, tape drives, CD-ROM drives, and diskette drives, and two DASD bays each holding up to six disk drives.

A PCI host bridge **130** provides an interface for a
15 PCI bus **131** to connect to I/O bus **112**. PCI bus **131** connects PCI host bridge **130** to the service processor mailbox interface and ISA bus access pass-through logic **194** and bridge chip **132**. The ISA bus access pass-through logic **194** forwards PCI accesses destined to the PCI/ISA
20 bridge **193**. The NV-RAM storage is connected to the ISA bus **196**. The Service processor **135** is coupled to the service processor mailbox interface **194** through its local PCI bus **195**. The service processor **135** has its own local memory **191**.

25 Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 1** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example
30 is not meant to imply architectural limitations with

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respect to the present invention.

With reference now to **Figure 2**, a block diagram of a system for updating SPCN firmware in a system with multiple I/O drawers is depicted in accordance with the present invention. System **200** provides more detail regarding the SPCN system of processing system **100** in **Figure 1** in which the SPCN firmware is to be updated. As discussed above, a system I/O drawer is a modular component for inserting I/O expansion slots into a data processing system. An I/O drawer physically packages several PCI Host Bridges (PHBs) to provide PCI I/O slots for plug-in I/O adapters.

System **200** includes four I/O drawers **202-208**, such as, for example, I/O drawers **144-150** in **Figure 1**. However, although depicted with four I/O drawers **202-208**, one skilled in the art will recognize that more or fewer I/O drawers may be included than depicted in **Figure 2**. It should also be noted that some of I/O drawers **202-208** may be connected to service processor **201** through RIO networks only, through SPCN buses only, or through both. The RIO Controller through which I/O drawers **202-208** would be connected to service processor **201** is not shown for clarity. Also not shown are the various connections between I/O drawers **210-216** with each other.

During the boot process of a power on event, service processor **201**, which may be implemented, for example, as service processor **135** in **Figure 1**, loads the new service processor firmware **206**, thus updating the service processor firmware, and executes this new service processor firmware to collect vital product data from

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each SPCN card **220-226**, in each I/O drawer **210-216**. Each SPCN card **220-226** may be implemented as, for example, SPCN cards **152-154** in **Figure 1**. Each I/O drawer **210-216** may be implemented as, for example, I/O drawers **144-150**

5 in **Figure 1**. The new firmware images have been previously loaded into the service processor's **201** flash memory **202** during a previous user session on the data processing system **200**. The new firmware images may include new system firmware **208**, new service processor
10 firmware **206**, and new SPCN firmware **204**. Each SPCN card **220-226** contains a SPCN flash memory **230-236** and a SPCN processor **240-246**. The SPCN flash memory **230-236** contains the SPCN firmware image that is executed by the SPCN processor **240-246** to manage power for the drawer
15 while aiding the service processor **201** in collecting the vital product information.

The service processor **201** also broadcasts the power on event to all tasks including the system power control network (SPCN) task on the SPCN card **220-226** within each
20 drawer within the system **210-216**. When each SPCN card **220-226** receives the power on event via the SPCN bus **218**, it collects information about the physical location of the drawer **210-216** in which it resides, the components within the drawer **210-216** in which it resides, as well as
25 other vital product information about its drawer and components within the drawer **210-216** and transmits this information to the service processor **201**. Once the service processor **201** has completed gathering vital product information, the service processor **201**
30 initializes the system, a process which includes

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providing power to the other components within the system **200**, such as, for example, referring to **Figure 1**, the processors **101-104**, local memories **160-163**, PCI host bridge **130**, etc.

5 The service processor **201** then copies the new system firmware **208**, that had previously been loaded and stored into flash memory **202**, into the system memory, such as, for example, local memories **160-163** in **Figure 1**, which then loads the new system firmware into the processors,
10 such as, for example, processors **101-104** in **Figure 1**, for execution. Thus, at this point, both the service processor firmware and the system firmware have been updated with the new firmware. However, to save time in initializing the system **200** and to allow a user to use
15 the system **200** sooner, each SPCN card's **220-226** copy of the SPCN firmware remains as is and is not updated until the system **200** has been completely initialized and the operating system is loaded and running. The service processor **201** then transfers control to the system
20 firmware running on the main system processors, such as processors **101-104** in **Figure 1**. The service processor **201** and the SPCN cards **220-226** then aid the system firmware in initializing (booting) the data processing system. At this time, although the service processor **201**
25 and main processors, such as, for example, **101-104** are executing updated firmware images, each SPCN processor **240-246** uses its current old version of the SPCN firmware to perform tasks requested of it by the system firmware.

30 Once the system firmware **206** has finished booting

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the system and finished loading the operating system (OS), the SPCN cards **220-226** and the service processor **201** will be notified that the OS is running. At this time, the service processor **201** will query each SPCN card **230** to determine the level (version) of the SPCN firmware residing in each SPCN cards SPCN flash memory **230-236**. If that level does not match with the SPCN firmware **204** on the service processor's **201** flash memory **202**, then the service processor **201** transmits a new firmware image to each SPCN card **220-226**, as necessary, using the SPCN firmware **204** stored on flash memory **202**. This process is performed in the background while the OS is running, thus enabling the user to utilize the data processing system while the firmware update is accomplished rather than having to wait until the firmware update is completed.

Those of ordinary skill in the art will appreciate that the components depicted in **Figure 2** may vary. For example, more or fewer I/O drawers may be utilized than depicted. Furthermore, the various firmware images may be stored in some other type of non-volatile memory other than flash memory **202**, such as, for example, a non-volatile random access memory (NV-RAM). The depicted example is not meant to imply architectural limitations with respect to the present invention.

With reference now to **Figure 3**, a flowchart illustrating an exemplary process for updating a new version of firmware for an SPCN card as a background operation is depicted in accordance with the present invention. Once a system power-on request has been received, such as, for example, in response to someone

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pushing a power button on the computer, the service processor runs the new updated service processor firmware stored in, for example, the SP firmware **198** section of flash memory **196** in **Figure 1**, and collects vital product data from the SPCN card within each drawer, such as, for example, SPCN cards **210-216** in **Figure 2** (step **302**). The new firmware may includes new system firmware, service processor firmware, and SPCN firmware and may have been loaded onto the data processing system from, for example, a web site, a diskette, CD-ROM, or DVD-ROM during a previous session and stored in a non-volatile memory device, such as, for example, flash memory **196** in **Figure 1**. The vital product data includes topology information such as, for example, the identity and number of components contained within each drawer and the physical location of each drawer so that, if there is a problem, a service technician may be directed to the correct location to service the system.

The data processing system is then initialized by the service processor (step **304**). Initialization includes such functions as, for example, testing and initializing processors, such as processors **101-104** in **Figure 1**, and testing and initializing memory and memory controllers, such as, for example, memories **160-163** and memory controller **108** in **Figure 1**. Control is then transferred to the system firmware (step **306**). Around the time that control is passed to the system firmware, the service processor copies the new system firmware that had previously been stored on a non-volatile memory, such as, for example, flash memory **196** in **Figure 1**, to system memory, such as, for example, local memories **160-163**,

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such that the new system firmware is executed on the system processors, such as, for example, processors 101-104 in **Figure 1**.

The service processor and the SPCN card then assist
5 the system firmware with system initialization (or booting) (step 308). During this process, since the SPCN card's SPCN firmware has yet to be updated, the SPCN card uses its previous versions of the SPCN firmware to assist the system firmware in initializing the data processing
10 system. During system initialization, the system firmware "walks" the system buses to verify connections and retrieves system configuration information previously discovered and stored by the service processor from the service processor memory, such as memory 191 in **Figure 1**
15 or via **Service Processor mailbox 194 in Figure 1**. Also, during system initialization, the system firmware locates and loads the operating system.

Once system initialization has been completed, the system firmware signals the service processor that
20 control has been transferred to the host operating system (step 310). It is at this point that the service processor is no longer needed by the system firmware and thus, may initiate any other tasks as needed. Thus, once the system firmware has released the service processor,
25 the service processor then updates the SPCN firmware by performing steps 312-324 as a background operation. Thus, the service processor queries the SPCN card for its current firmware level (step 312). The service processor then compares the retrieved firmware level of the SPCN
30 card with the stored copy, such as SPCN firmware copy 199 in flash memory 196 in **Figure 1**, received at the last

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 5 user requested update (step **314**) and determines whether the two match (step **316**). If the SPCN current firmware level matches the stored copy of the firmware, then the firmware is up to date and no further action is necessary.

10 If the firmware level of the SPCN card does not match the stored copy of the firmware, then the stored new image of the SPCN firmware is transferred to the SPCN card of each drawer in the data processing system (step **318**). Thus, for example, referring to **Figure 2**, the SPCN firmware image **204** in flash memory **202** is transferred to the SPCN cards **220-226** of each of I/O drawers **210-216**, where it is stored in a respective SPCN flash memory **230-236** to be used by SPCN processors **240-246**. Returning
 15 to **Figure 3**, once the transfer is complete, then the service processor queries the SPCN card for the current level of the SPCN's firmware and compares to the level sent (step **320**) to determine if the two match (step **322**). If the two do match, then the SPCN card's firmware has
 20 been successfully updated and no further action is necessary. If the two still do not match after attempting to update the SPCN card's level of the firmware, then a firmware update failure is logged to notify the user (step **324**); the system continues with
 25 normal operation.

30 In prior art systems, the SPCN firmware of each drawer was updated around the same time as the system firmware was updated. However, although updating the system firmware and service processor firmware are relatively quick operations, updating the SPCN firmware is a very time consuming operation and may take up to

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approximately 15 minutes per I/O drawer. Therefore, with a system such as depicted in **Figure 1** having four I/O drawers **144-150**, the update to the SPCN firmware might take around an hour. However, step **308** cannot be

5 performed while the SPCN firmware is being updated since the SPCN cards will not be available to assist the system firmware in initialization of the data processing system until the update is complete. Therefore, when a firmware update was performed, a user was forced to wait for a
10 prolonged period of time before the operating system was loaded and running allowing the data processing system to be used for other purposes other than firmware updates. Therefore, by delaying updating the SPCN firmware until
15 the update in the background, the user may use the data processing system much sooner than was possible in the prior art.

It is important to note that while the present invention has been described in the context of a fully
20 functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention
25 applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard disk drive, a RAM, and CD-ROMs and transmission-type
30 media such as digital and analog communications links.

The description of the present invention has been

presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

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